A quantum fiber-pigtail

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Semiconductor quantum-dots (QDs) are attractive single photon sources. They are robust, compact and provide on-demand single photons at rates in the GHz range. For practical applications, an important challenge is to efficiently couple the emitted light into a single mode fiber. Large progress in this direction has been made with the integration of QDs into micro and nano-scale photonic structures, such as cavities and waveguides, which allow the control of spontaneous emission [1-3]. In the last few years, important efforts to position the QD in an optimal way [4,5] and to minimize the diffraction of light at the output of photonic nanowires [6] have pushed the collection efficiencies to values 75% while maintaining a Gaussian spatial profile [7,8]. These impressive results require however the use of objective lenses with large numerical apertures. In parallel, different strategies to couple the emitted light directly into a single mode fiber have emerged [9-11].

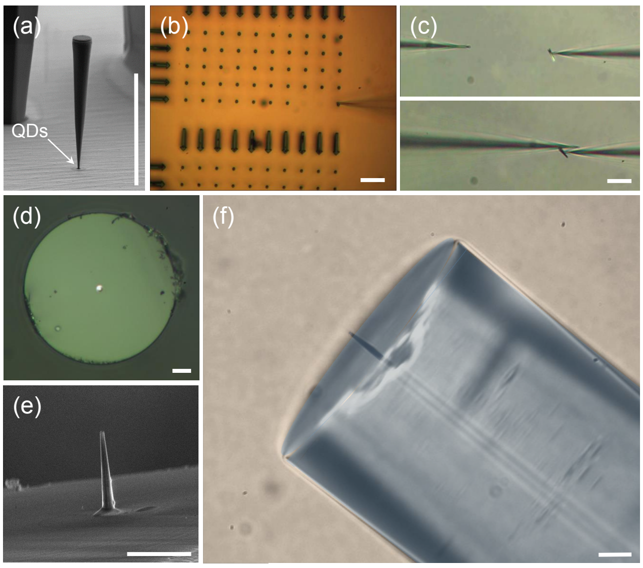

Figure 1. **Fabrication procedure.** a) SEM picture of the photonic trumpet after etching and removal of the Ni mask. b) Removing a single PW from its original substrate with glass micro-manipulator (right side). c) Orientation of the PW for subsequent gluing onto the fiber. d) Top view of the bare fiber with a drop of UV glue (bright spot) deposited at its center. e) SEM picture of the fiber-wire connection. The drop of glue can be seen at the base of the PW. f) Side view of the final device (optical microscope image). The white scale bars represent 10 µm.

We present the experimental realization of a quantum fiber-pigtail. The device consists of a semiconductor quantum-dot embedded into a conical photonic wire that is directly connected to the core of a fiber-pigtail. We demonstrate a photon collection efficiency at the output of the fiber of 5.8%. The result represents a proof-of-principle for an easy-to-operate single photon source. We discuss realistic improvements and show that an efficiency exceeding 70% is within reach with current technology. Furthermore, easily addressable QDs at the end of a nanometer-scale tip have obvious potential as scanning probes. Possible applications include single photon near-field microscopy [12], deterministic quantum plasmonics [13] or electric field sensing [14].

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